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APPLICATION FOR LETTERS PATENT

TITLE: IMAGE SYNTHESIZING APPARATUS AND IMAGE
                SYNTHESIZING METHOD

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IMAGE SYNTHESIZING APPARATUS

AND IMAGE SYNTHESIZING METHOD

BACKGROUND OF THE INVENTION

The present invention relates to an image synthesizing apparatus for synthesizing two pieces of image data and outputting synthesized image data, and particularly to an image synthesizing apparatus for effecting image synthesis by using an α blending method.

Recently, functions of a television receiver have been diversified. Since conventional mechanical switches such for example as buttons provided on the body of the television receiver and a remote control are not sufficient for setting the functions of the television receiver, the functions are more often set by menu operation such as displaying a menu image on a monitor screen, selecting a setting item, and supplying an input on a displayed setting screen. In some of such cases, an image for menu operation is superimposed on a television image currently selected for viewing by a television tuner on the monitor screen.

Fig. 7 shows an example of a display screen of a television receiver for such menu operation.

Fig. 7 shows a menu screen 71 to be superimposed, a

television screen 72 selected by a television tuner or the like, and a synthesized screen 73 in which the menu screen 71 is superimposed on the television screen 72. Selection buttons 71a, 71b, and 71c shown on the menu screen 71 for example represent a "sound selection" button for switching between a main-channel sound and a sub-channel sound, a "channel" button for setting the display number of a channel, and a "return" button for stopping the display of the menu screen, respectively.

The television screen 72 being viewed can be seen through the menu selection buttons 71a, 71b, and 71c on the synthesized screen 73 in which the menu screen 71 is superimposed on the television screen 72. An image synthesizing method that makes one image seen through the other image in such a manner is referred to as α blending. This processing method is often used for menu operation on a television screen.

According to the α blending method, when an image to be superimposed is set to be A, a background image is set to be B, and a blending coefficient α is set to be α ($0 \leqq \alpha \leqq 1$), an operation is performed on each element forming respective one of the images A and B so that an output image S satisfies the following equation, and then the result is outputted.

$$S = A * \alpha + B * (1 - \alpha)$$

An arbitrary value in a range of $0 \leqq \alpha \leqq 1$ is selected for the blending coefficient α to thereby define transparency; when α is zero, the image A to be superimposed on the image B is completely transparent, while when α is unity, the image A to be superimposed on the image B is completely opaque.

When the menu screen is superimposed on the television screen by using the α blending method as described above, the blending coefficient α is generally determined for each menu screen using a table referred to as a color look-up table (hereinafter referred to as a CLUT).

Fig. 8 shows an example of a CLUT. In Fig. 8, Y, Cb, and Cr are picture element components that form a picture element, and Y represents a luminance component while Cb and Cr represent color difference components. Coordinate values represent coordinates (x, y) of a picture element on a monitor screen obtained when an x-component is taken in a horizontal direction and a y-component is taken in a vertical direction. In order to simplify description, it is assumed that only four sets of coordinates are present in Fig. 8. The values of the luminance component Y, the color difference component Cb,

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the color difference component Cr, and α are converted into 8-bit data for convenience of operation.

In order to change transparency of a synthesized screen for each picture element, the α blending method using a CLUT requires information on an α value for each picture element, as shown in Fig. 8. Therefore, the finer the picture elements on a monitor screen, the larger the amount of information of the CLUT, thereby increasing memory size and the load of the above-mentioned operation processing, and thus decreasing image-generating rate. In order to deal with the problem, circuit scale, power consumption, and cost of the television receiver must be increased.

SUMMARY OF THE INVENTION

The present invention has been made in view of the above problems. It is an object of the present invention to provide an image synthesizing apparatus that reduces the amount of data handled in image synthesis processing by α blending and thereby reduces the load of image synthesis processing.

It is another object of the present invention to provide an image synthesizing method that reduces the amount of data used for α blending and thereby reduces

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the load of image synthesis processing.

In order to solve the above problems, according to an aspect of the present invention, there is provided an image synthesizing apparatus for synthesizing two images, including coefficient setting means for setting a blending coefficient α ($0 \leqq \alpha \leqq 1$) at a specified value when a value of a specific picture element component included in picture element components A of a first image is a predetermined value; and arithmetic means for performing an operation on the picture element components A, picture element components B of a second image, and the blending coefficient α as follows:

$$A * \alpha + B * (1 - \alpha)$$

and performing the operation on all the picture element components A and the picture element components B of a picture element that has the specific picture element component representing the predetermined value by using the blending coefficient α set by the coefficient setting means.

When a specific component of a picture element that forms the first image represents a predetermined value, the image synthesizing apparatus according to the present invention performs α blending operation by the arithmetic means on all the picture element components of the

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picture element by fixing the blending coefficient α at a specified value, thereby eliminating the need for setting the blending coefficient α for every picture element. Thus, the amount of information for the operation is reduced, and thereby it is possible to reduce required memory capacity and the load of image processing.

According to another aspect of the present invention, there is provided an image synthesizing method for synthesizing two images, wherein an operation is performed on picture element components A of a first image, picture element components B of a second image, and a blending coefficient α ($0 \leqq \alpha \leqq 1$) as follows:

A * α + B * (1 - α)

and when a specific picture element component included in the picture element components A represents a predetermined value, the blending coefficient α is set at a specified value in the operation on all the picture element components A and the picture element components B of a picture element that has the specific picture element component representing the predetermined value.

According to the image synthesizing method, when a specific component of a picture element that forms the first image represents a predetermined value, α blending operation is performed on all the picture element

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components of the picture element by fixing the blending coefficient α at a specified value, thereby eliminating the need for setting the blending coefficient α for every picture element. Thus, the amount of information for the operation is reduced, and thereby it is possible to reduce required memory capacity and the load of image processing.

The above and other objects, features and advantages of the present invention will become apparent from the following description and the appended claims, taken in conjunction with the accompanying drawings in which like parts or elements denoted by like reference symbols.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram for illustrating principles of the present invention;

Fig. 2 is a schematic diagram of image data;

Fig. 3 shows an example of screens to be synthesized;

Fig. 4 is an enlarged view of a menu screen shown in Fig. 3;

Fig. 5 shows an example of the main configuration of an image synthesizing apparatus according to the

present invention;

Fig. 6 is a flow chart of image synthesis processing by an image synthesizing unit;

Fig. 7 shows an example of a display screen of a television receiver for menu operation; and

Fig. 8 shows an example of a color look-up table (CLUT).

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Preferred embodiments of the present invention will hereinafter be described with reference to the drawings.

Fig. 1 is a block diagram for illustrating principles of the present invention.

An image synthesizing apparatus 1 synthesizes a first image 1a and a second image 1b at arithmetic means 1d by α blending to output data of a synthesized image to a display unit 2 or the like. The first image 1a and the second image 1b are each formed by a set of a plurality of adjacent picture elements, and each of the picture elements is formed by a plurality of picture element components. The synthesized image S is outputted after the following operation:

$$S = A * \alpha + B * (1 - \alpha) \quad (0 \leqq \alpha \leqq 1)$$

where picture element components of the first image 1a

are A, picture element components of the second image 1b are B, and α is a blending coefficient for defining transparency; when α = 0, the first image 1a is completely transparent while when α = 1, the first image 1a is completely opaque. The image synthesizing apparatus 1 performs such an operation on picture element components of all the picture elements that form each image.

Coefficient setting means 1c in the image synthesizing apparatus 1 detects data of a specific picture element component from the picture element components A that form the first image 1a. When the data represents a predetermined value, the coefficient setting means 1c sets the blending coefficient α used for the blending operation at a specified value. The arithmetic means 1d performs the above operation on all picture element components A and B. At this point, the arithmetic means 1d performs the above operation on all picture element components A and B of the picture elements whose specific picture element components represent the predetermined value by using the blending coefficient α set by the coefficient setting means 1c. Synthesized image data outputted after the arithmetic means 1d has performed the operation is displayed on the display unit

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2 as a synthesized image or stored in a memory not shown
in the figure.

When the picture element components A and B are
formed by two kinds of components, that is, a luminance
component Y and a color difference component Cb or Cr,
for example, the coefficient setting means 1c detects the
value of the luminance component Y from all the picture
element components A of the first image 1a, and when the
value of the luminance component Y is zero, the
coefficient setting means 1c sets the blending
coefficient α at zero. According to the setting by the
coefficient setting means 1c, the arithmetic means 1d
performs the operation on all the picture element
components, that is, the luminance component Y and the
color difference component Cb or Cr of a picture element
whose luminance component Y is zero by setting the
blending coefficient α to be zero. As a result, when the
picture elements of the first image 1a have a zero
luminance component Y, the first image 1a becomes
completely transparent in the displayed synthesized image
and therefore is not displayed on the screen, and only
the second background image 1b is displayed.

Such processing by the coefficient setting means 1c
and the arithmetic means 1d is realized by a processor, a

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ROM (Read Only Memory) and a RAM (Random Access Memory) using semiconductors, or an integrated circuit designed specifically for that purpose, for example.

A specific example of processing by the image synthesizing apparatus 1 will next be described in detail.

In the present embodiment, image data in an ITU-601 format, which is referred to as a 4:2:2 format, is used as an example of data of an image to be displayed. Incidentally, ITU stands for the International Telecommunication Union.

Fig. 2 is a schematic diagram of image data.

Picture element components of the image data in the 4:2:2 format are represented by luminance components Y and color difference components Cb and Cr, which are each formed by 8-bit data. The sampling frequency of the luminance component Y is 13.5 MHz, while the sampling frequency of the color difference components Cb and Cr is 6.75 MHz. Since of the color difference components Cb and Cr, one with a higher frequency component can be discarded, each picture element 22 in a display screen 21 is formed by a combination of two picture element components, that is, a luminance component Y and a color difference component Cb or a luminance component Y and a color difference component Cr, as shown in Fig. 2.

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Although the actual value of the luminance component Y

ranges from 0 to 1 and the actual value of the color

difference components Cb and Cr ranges from -0.5 to 0.5,

data of these components is converted into 8-bit form in

the 4:2:2 format, and it is specified that the luminance

component Y, the color difference component Cb, and the

color difference component Cr range from 16 to 235, from

16 to 240, and from 16 to 240, respectively.

According to the present invention, attention is

directed to a specific component of the picture element

components in setting the blending coefficient α used for

the above-mentioned operation so that the blending

coefficient α is set according to the value of the

specific component. An example in which the luminance

component Y is used as the specific component will be

described in the following.

Fig. 3 shows an example of screens to be

synthesized. Fig. 4 is an enlarged view of a menu screen

31 shown in Fig. 3.

In the example shown in Fig. 3, the menu screen 31

for setting various functions of the television receiver

is superimposed on a television screen 32 selected for

viewing by a TV tuner or the like. Specifically, the

aforementioned first image 1a in Fig. 1 corresponds to

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the menu screen 31 to be superimposed and the second

image 1b corresponds to the television screen 32 being

viewed. The menu screen 31 and the television screen 32

are both in the 4:2:2 format, and thus are obtained from

image data comprising the same number of picture elements,

for example 720 × 480.

When the operation for synthesizing these images by

α blending is performed, the blending coefficient α is

set according to the value of the luminance component Y

forming each picture element of the menu screen 31 to be

superimposed. The luminance component Y of the menu

screen 31 assumes values other than the specified values

(16 to 235) of the luminance component Y to know the

setting of the blending coefficient α.

For example, when the luminance component Y is zero,

the blending coefficient α is set at zero, while the

luminance component Y is other than zero, the blending

coefficient α is set at unity. When the luminance

component Y of a picture element is zero, operation on

not only the luminance component Y but also the color

difference components Cb and Cr of the picture element is

performed by setting the blending coefficient α at zero.

Similar operation is performed when the luminance

component Y is other than zero. Such operation is

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performed on all picture elements.

In Figs. 3 and 4, selection buttons 31a, 31b, and 31c shown on the menu screen 31 for example represent a "sound selection" button for switching between a main-channel sound and a sub-channel sound, a "channel" button for setting the display number of a channel, and a "return" button for stopping the display of the menu screen, respectively.

Since monitor display for function setting is not necessary in a shaded portion 31d of Fig. 4 that does not include portions of the selection buttons 31a, 31b, and 31c, the luminance components Y of picture elements in the shaded portion 31d are set at zero. Thus, operation on all picture elements included in the shaded portion 31d is performed by setting the blending coefficient α at zero, whereby only the background television screen 32 is displayed in a synthesized screen 33 shown in Fig. 3. Luminance components Y in the portions of the selection buttons 31a, 31b, and 31c have numerical values set within a specified range of values that indicate normal image components. Thus, operation on picture elements in the portions of the selection buttons 31a, 31b, and 31c is performed by setting the blending coefficient α at unity, whereby only the selection buttons 31a, 31b, and

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31c are displayed on the synthesized screen 33, as shown in Fig. 3.

It is to be noted that the blending coefficient α is not limited to zero and unity as set in the above example. For example, the blending coefficient α may be set at zero when the luminance component Y is zero, and the blending coefficient α may be set at 0.5 when the luminance component Y is other than zero. In this case, the portions of the selection buttons 31a, 31b, and 31c when the luminance components Y are other than zero will be displayed on the synthesized screen 33 of the monitor as an image of the menu screen 31 being superimposed on the television screen 32.

Thus, operation is performed by setting the blending coefficient α according to the value of the luminance component Y, thereby eliminating the need for a conventionally required CLUT in which a blending coefficient α is assigned to each picture element. Therefore, a memory for storing the CLUT having a large amount of data is not required, thereby reducing the scale and the power consumption of the circuit to be mounted in the apparatus. In addition, the stepwise setting of the blending coefficient α makes it possible to achieve a simpler configuration of a circuit for

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performing the operation and thereby increase processing rate in image synthesis.

Moreover, since the ITU-601 format employed in the example described above specifies that the value of the luminance component Y is 16 to 235, the value of the luminance component Y = 0 is not included in a range of values that can be assumed by original image data. Therefore, the value of the luminance component Y = 0 does not affect display of image data for an image having luminance components Y set at such values, that is, the menu screen 31 as shown in Fig. 3. Thus, the value of the luminance component Y for setting the blending coefficient α at zero may be any of 0 to 15.

Even in the case of image data in a different format from ITU-601, when a range of values assumed by the data is determined, the present invention can be carried out by assigning data having a value outside the range. According to the specifications of the ITU-601 format employed in the example described above, each picture element includes a luminance component Y without exception, and therefore a luminance component Y is used to know a setting value of the blending coefficient α. However, when image data in a different format includes a color difference component or a color component without

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exception, for example, the color difference component or the color component may be used for the above purpose.

Next, Fig. 5 shows an example of the main configuration of an image synthesizing apparatus according to the present invention.

An image synthesizing apparatus 1 comprises a microcomputer 11, an image generation control unit 12, a memory 13, a memory control unit 14, an image generating unit 15, an image synthesizing unit 16, and an image output unit 17. The image synthesizing apparatus 1 captures moving images generated by a moving image generating apparatus 3, and synthesizes an image stored in the memory 13 with each of the moving images to output the result to a monitor 2 for display. The image synthesizing apparatus 1 is for example disposed inside a television receiver, in which case a television image receiving apparatus corresponds to the moving image generating apparatus 3, and the image synthesizing apparatus 1 superimposes a menu image or the like generated by the microcomputer 11 upon a received television image to thereby display the result on the monitor 2.

The microcomputer 11 is connected to the image generation control unit 12 and the memory control unit 14,

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and controls the image generating unit 15, the image

synthesizing unit 16, and the image output unit 17 via

the image generation control unit 12. The memory control

unit 14 controls memory access by the microcomputer 11

and the image generating unit 15, and also writes and

reads various data to and from the memory 13. Functions

of the image generation control unit 12, the memory

control unit 14, the image generating unit 15, and the

image synthesizing unit 16 are realized by control and

processing by a processor, a ROM and a RAM that use

semiconductors and the like, or an integrated apparatus

designed specifically for that purpose. The memory 13 is

a ROM and RAM using semiconductors and the like, or a

hard disk formed by a magnetic disk or the like.

The microcomputer 11 generates encoded image data

in which image data such as luminance components Y, color

difference components Cb, and color difference components

Cr is encoded, and then writes the encoded image data to

the memory 13 via the memory control unit 14. In

generating the encoded image data, image data inputted

from another image generating apparatus by an input unit

not shown in the figure provided for the image

synthesizing apparatus 1 is encoded into specified data

form by control and processing by the microcomputer 11 to

be stored in the memory 13. The memory 13 also stores

specified information such as a display position and a

display size of image data to be displayed on the monitor

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When processing for image synthesis begins, the

encoded image data and information such as its display

position and display size are supplied from the memory 13

to the image generating unit 15 via the memory control

unit 14. The image generating unit 15 decodes the encoded

image data according to a control signal from the image

generation control unit 12 to thereby generate decoded

image data, and then outputs the decoded image data to

the image synthesizing unit 16 as image data for display

on the monitor 2.

Under control of the image generation control unit

12, the image synthesizing unit 16 reads the decoded

image data from the image generating unit 15 and moving

image data from the moving image generating apparatus 3.

The image synthesizing unit 16 sequentially reads picture

element components that form picture elements from these

pieces of data, and obtains the value of a luminance

component Y from the picture element components of the

decoded image data. The image synthesizing unit 16 sets a

blending coefficient α corresponding to the value of the

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luminance component Y by using information on the
relation between the luminance component Y and the
blending coefficient α supplied from the image generation
control unit 12. Then the image synthesizing unit 16
performs α blending operation by using the blending
coefficient α set for a picture element of the moving
image data and the decoded image data that includes the
luminance component Y, and thereafter outputs the result
to the image output unit 17. The information on the
relation between the luminance component Y and the
blending coefficient α may be preset in the image
generation control unit 12, or the relation between the
luminance component Y and the blending coefficient α may
be specified by the user and stored in the memory 13 or
the like by an input unit not shown in the figure so that
the relation between the luminance component Y and the
blending coefficient α is read by the image synthesizing
unit 16.

The image output unit 17 is connected to the
monitor 2, and according to a control signal from the
image generation control unit 12, converts display image
data of a synthesized image generated at the image
synthesizing unit 16 into a data form for output that
enables display of the data on a display screen of the

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monitor 2.

Fig. 6 is a flow chart of image synthesis processing by the image synthesizing unit 16.

When image synthesis processing begins, encoded image data stored in the memory 13 is read to be decoded by the image generating unit 15, and decoded image data for each picture element is supplied to the image synthesizing unit 16 (S61). At the same time, moving image data for each picture element at the same position, serving as a background of the image of the decoded image data, is supplied from the moving image generating apparatus 3 to the image synthesizing unit 16 (S62).

Next, the image generation control unit 12 supplies information on relation between the luminance component Y and the blending coefficient α of the decoded image data (S63). Under the control of the image generation control unit 12, the luminance component Y is detected from picture element components included in picture elements of the read decoded image data, and is then subjected to comparison with the information on the relation between the luminance component Y and the blending coefficient α (S64). The value of the blending coefficient α corresponding to the detected luminance component Y is set according to the information (S65). Then, α blending

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operation is performed on each picture element component by using the set blending coefficient α (S66). Synthesized image data obtained from the picture element components after the operation is outputted to the image output unit 17 (S67). When display of a synthesized image is to be continued (S68), a picture element at the next position is read from the decoded image data and the moving image data (S61), and thereafter the same operation is performed on picture element components of the picture element.

After operation on all the picture elements of one image is finished, the moving image generating apparatus 3 supplies the next piece of moving image data for operation on each picture element of the next image. Thus, a loop from S61 to S67 is repeated until display of a synthesized image is stopped and thereby image synthesis processing is finished.

It is to be noted that in the embodiment described above, the background image is a moving image and the image to be superimposed is a still image; however, these images may be either a moving image or a still image as long as the image to be superimposed has specific data written into the luminance components Y of picture elements that do not need to be displayed on the monitor.

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Thus, the present invention is applicable regardless of whether these images are moving images or still images.

As described above, when a specific component of a picture element that forms one image represents a predetermined value, the image synthesizing apparatus according to the present invention performs α blending operation on all the picture element components of the picture element by fixing the blending coefficient α at a specified value, thereby eliminating the need for setting the blending coefficient α for every picture element. Thus, the amount of information for the operation is reduced, and thereby it is possible to reduce required memory capacity and the load of image processing.

In addition, when a specific component of a picture element that forms one image represents a predetermined value, the image synthesizing apparatus according to the present invention performs α blending operation on all the picture element components of the picture element by fixing the blending coefficient α at a specified value, thereby eliminating the need for setting the blending coefficient α for every picture element. Thus, the amount of information for the operation is reduced, and thereby it is possible to reduce required memory capacity and the load of image processing.

While a preferred embodiment of the present invention has been described using specific terms, such description is for illustrative purposes only, and it is to be understood that changes and variations may be made without departing from the spirit or scope of the following claims.